COMPREHENSIVE WATER AND RELATED LAND RESOURCES INVESTIGATION

CHARLES RIVER WATERSHED

PLAN OF SURVEY

Department of the Army
New England Division, Corps of Engineers
Waltham, Mass.

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PLAN OF SURVEY

FOR

COMPREHENSIVE WATER AND RELATED

LAND RESOURCES INVESTIGATION

CHARLES RIVER WATERSHED

MASSACHUSETTS

1. INTRODUCTION

The plan of survey sets out the procedures to be followed in developing a comprehensive plan for the Charles River Watershed. It is to be used as a management tool to assist in orientation, direction, and coordination, as well as to show the interrelationships and missions between the participants within the study. It is intended that it be flexible, undergoing periodic modification as required.

2. AUTHORITY FOR STUDY

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, ADOPTED JUNE 24, 1965.

> "That the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Land and Water Resources of the New England-New York Region printed in Senate Document Numbered 14, 85th Congress, First Session, with particular reference to the Charles River Basin and tributaries, Massachusetts, with a view to determining the advisability of improvements in the interest of flood control, water supply, recreation, water quality control, navigation, tidal flood control, allied purposes and related land resources."

3. OBJECTIVE OF INVESTIGATION

The basic objective of the Charles River Watershed* survey is the formulation of a plan of development which will serve as a guide for the

* An impoundment formed by the Charles River dam located near the mouth of the river is known locally as the Charles River Basin. To avoid confusion, the entire area draining to the Charles River will be referred to throughout the remainder of this report as the "Charles River Watershed."

best use, or combination of uses, of water and related land resources in the watershed to meet foreseeable short and long-term needs. To this end, consideration will be given to meeting present and future requirements for water supply, flood control, navigation, water quality control, recreation, fish and wildlife, and other purposes requiring development of water and related land resources. The investigations will emphasize formulation of a detailed plan to meet these needs through 1980 and indicate potentials to meet the needs through 2020. The plan will include components to supplement existing and currently planned developments so as to meet the 1980 needs of the basin. Measures capable of meeting longer term requirements will be incorporated in the plan.

4. WATERSHED DESCRIPTION

The Charles River watershed is located in eastern Massachusetts bordering on the watersheds of the Mystic, Merrimack, Blackstone, Taunton and Neponset Rivers and includes all or portions of 5 cities and 29 towns. Only minor portions of Arlington, Ashland, Mendon and Wayland fall within the watershed and have been eliminated from the Watershed study area. The Watershed is about 300 square miles including an important and highly developed portion of Metropolitan Boston and less developed but rapidly growing suburban and rural areas.

The 30 cities and towns wholly or partially within the watershed study area are as follows:

1. Bellingham
2. Belmont
3. Boston (2)
4. Brookline (1)
5. Cambridge (2)
6. Dedham
7. Dover
8. Franklin
9. Holliston
10. Hopedale
11. Hopkinton
12. Lexington
13. Lincoln
14. Medfield
15. Medway (1)
16. Milford
17. Millis (1)
18. Natick
19. Needham (1)
20. Newton (1)(2)
21. Norfolk (1)
22. Sherborn
23. Somerville (2)
24. Walpole
25. Waltham (1)(2)
26. Watertown
27. Wellesley (1)
28. Weston
29. Westwood
30. Wrentham

(1) Wholly in watershed
(2) City government

The basin is hour-glass in shape with a length in a southwest-northeast direction of 31 miles and widths of 15, 6 and 15 miles in a northwest-southeast direction. Elevations vary from 586 feet, mean sea level, along the southwesterly rim of the basin in Hopkinton to below 10 feet, msl, along the lower $8\frac{1}{2}$ miles of the Charles River.

The estimated 1965 watershed population is 854,000. About 75% of this total is in the cities of Boston, Cambridge, Somerville, Newton and Waltham and the towns of Brookline and Watertown, all located in the lower portion of the watershed. In the ten-year period 1955-1965, there has been a small decline in total population within these six communities whereas the other 24 communities in the watershed have generally experienced rapid growth and development.

The Metropolitan District Commission (MDC), a State agency, provides water, sewer and park services for 15 of the 30 communities embracing about 40 percent of the area. Twenty-five of the 30 municipalities are included within the Boston Standard Statistical Metropolitan Area and contain much of the highest value real estate in the Commonwealth.

Precipitation as both rain and snow averages 44.4 inches of water per year within a range of 43 to 47 inches. Runoff in the upper 80 percent of the watershed averages 22 inches. The runoff from the lower 20 percent which is highly urbanized is considerably higher, and it is estimated that 89 percent of the flood peaks in the Charles River Basin originate within this lower watershed area.

5. CURRENT STATUS OF WATER AND RELATED LAND RESOURCES IN THE BASIN.

a. Navigation. Until about 1910, the $8\frac{1}{2}$ mile reach of the Charles River from the mouth at Boston Harbor to a dam at Watertown was tidal with a range of tide of 9.5 feet. With the construction of a dam in 1910 with navigation lock and sluice gates, this reach was converted to a fresh water basin with a fixed level of 2.4 feet above msl. For many years the lock was adequate for decreasing commercial navigation and the increasing recreational boating. Doubt now exists of the ability of lock to handle present and future boat traffic efficiently.

Navigation in the river above Watertown Dam is restricted to shallow draft pleasure boats such as canoes, kayaks, and shallow draft outboard motor boats. The Watertown Dam, now being rebuilt, and the many upstream dams lack facilities to lift boats from level to level. Natural channels are narrow and shoal and there are numerous obstacles, such as rocks and trees.

b. Flood Control. The existing Charles River dam completed in 1910 separating the river from the tidal water of Boston Harbor has provisions for gravity sluicing of the river flow. The tide level is above Basin level for one-third of the time during normal tides and for one-half of the time during storm tides. Gravity discharge is impossible at those times and the Basin is completely out of control. The resulting water surface elevation in the Basin is determined solely by the quantity of inflow and the storage capacity coincidentally available to absorb the flow.

Increased urban development in the Watershed has increased the flood problems. The situation is particularly acute in the Charles River Basin area between the Charles River Dam and Watertown where urbanization has increased the rapidity and volume of runoff and encroachment by highway and other improvements in recent years has reduced the storage capacity of the impoundment by elimination of extensive swamp which bordered the original 1910 impoundment.

The Metropolitan District Commission has altered the spillway crests of two upstream dams and improved a section of channel in the interest of flood control. The Commission has also constructed an adjustable control gate at Mother Brook and improved a section of Mother Brook Channel which empties into the Neponset River. A plan by the Commission calls for further improvement of the Charles River Channel.

The Waterways Division, Massachusetts Department of Public Works, has completed a short section of channel improvement and is completing a conduit enclosing the Charles River in the town of Milford.

c. Pollution. Municipal and industrial wastes in various stages of treatment are emptied into the stream throughout most of its length. Pollution has been particularly severe in the lower 25 miles where overloaded MDC intercepting sewers formerly relieved raw sewage into the river. MDC improvements costing over $110,000,000 were placed in operation in 1966 to eliminate this source of pollution.

During periods of extreme low flow in the river, the MDC has provided as much as 15 million gallons of water per day from its reservoir at Lake Cochituate to increase flow and relieve pollution in the river.

d. Water Supply. The principal source of water for the Boston Metropolitan District is from outside the Charles River Watershed. The Metropolitan District Commission supplies water for 10 of the cities and towns representing about 60 percent of the population of the watershed from what is considered to be the largest domestic water supply reservoir in the world (415 billion gallons).

The City of Cambridge and the towns of Lincoln and Milford obtain water from surface sources within the watershed. The Cambridge supply is supplemented by MDC. Dedham and Wellesley are supplied from dug, gravel packed and tubular wells fed from the Charles River. Needham receives about 50% of its supply from MDC, the remainder from wells within the town. The remaining towns derive their domestic water supply from ground water sources.

e. Recreation. The original concepts of the Charles River Dam Commission early in this century included the maximum utilization of the Basin and shoreline for park and recreation purposes. As a consequence, most of the basin shoreline and portions of river banks along the lower 10 miles of the River are now in Metropolitan District ownership. Development and use of this property has generally followed recreational demand. A policy of further acquisition through fee or by easements is now being followed.

The possibilities of recreational development along and in areas related to the Charles and its tributaries throughout the Watershed are almost unlimited and much needed for the great recent suburban growth in the area. There are opportunities for all forms of active and passive recreation. The principal obstacles include poor water quality, low flow conditions and urban development of potential recreation sites. The acquisition, improvement, maintenance and proper designation of recreation areas has not kept pace with population shifts.

6. DESIRES OF LOCAL INTERESTS

Determination of the desires of local interests and indication of means for resolving of conflicts will be an important part of the investigation. The numerous state and local governmental agencies and local groups in the watershed have expressed desires which in part include:

a. Review of the flood problem in the Basin and in the Muddy River.

b. Review of solution for the Basin flood and navigation problem proposed by the Metropolitan District Commission. A report prepared for the Commission recommends a new dam downstream of the existing 1910 Charles River dam with more adequate locks and sluice gates and a pumping station. Consideration of this and other proposals involves other proposed developments such as the Inner Belt Highway and Mass. Bay Transit Authority construction.

c. Consideration of means to prevent encroachment on the flood plain and other areas adjacent to the Charles River and its tributaries

upstream of the Watertown dam. It is recognized that the flood problems in the Charles River Basin area have resulted from encroachment on the Basin, extensive filling and high utilization of land areas. Continued filling of natural storage areas and high land utilization without adequate provision for open areas will lead to economic and aesthetic losses in the near future.

d. Consideration of multiple-purpose storage in the headwaters for recreation, flood control and low flow augmentation.

e. Conservation of open spaces throughout the basin and increased recreation development. The desires and needs for industrial and commercial expansion, highway construction and housing development are not known at this time. These important factors and their effects on runoff water demands and pollution will be given careful consideration in the study.

7. COORDINATION

The Division Engineer, New England Division, Corps of Engineers, has been assigned the major responsibility for the accomplishment of the study. Assistance and guidance is afforded by the Coordinating Committee comprised of representatives of each of the participating Federal agencies and representatives designated by the Governor of Massachusetts. The Division Engineer, as Chairman, will direct the Committee's periodic review of the progress of the study. Committee's functions include the following:

a. Offer guidance.

b. Apprise the heads of Federal agencies and of State and local agencies of the progress and the trends of the studies.

c. Resolve differences or indicate available means for resolving differences, possibly outside the Committee.

d. Assist in coordinating efforts of participants, and

e. Aid in presenting to the public the results of the coordinated comprehensive planning effort.

The Committee will be as follows:

Chairman - Division Engineer
New England Division, Corps of Engineers
Colonel Remi O. Renier

Membership

Commonwealth of Massachusetts

Member or Members to be appointed by Governor

Federal

Department of Agriculture
Department of Commerce
Department of Interior
Department of Health, Education & Welfare
Department of Housing & Urban Development

In addition to the Coordinating Committee, a "Citizen's Advisory Committee" will be formed of officials and residents of the 30 municipalities in the watershed representing many and diverse interests. The Committee will provide valuable information on specific desires, problems and conflicts which exist in the watershed.

8. PARTICIPATION OF AGENCIES

Federal agencies will participate in varying degrees with the Corps of Engineers in the study. Their efforts are funded by transfers from the Corps or directly. Several agencies of the State assist in the investigations by providing available data from State studies, and advice to the participating Federal agencies. Contacts between the Federal and State agencies will be facilitated by the Coordinating Committee. The needs and desires of the state in the development of water resources are being ascertained through the Coordinating Committee which also is utilized to consolidate and reconcile participant's views.

A. DEPARTMENT OF THE ARMY

(1) Corps of Engineers is to:

(a) Coordinate efforts and provide guidance and pertinent data for the investigations undertaken by cooperating agencies as necessary inputs to any specific overall study effort and arrange for and hold conferences and meetings as needed in connection with the study.

(b) The Corps will develop through contractural services, a series of projections of those economic indices most indicative of present and future uses of water and related land resources.

(c) Determine the magnitude of present and future requirements for major flood control measures including local protection and drainage improvements. Evaluate flood problems and measures to lessen these problems in cooperation with the Department of Agriculture.

(d) Determine the magnitude of present and future requirements for commercial and recreational navigation facilities and determine measures to satisfy these requirements.

(e) Conduct necessary hydrological studies of the Watershed to determine streamflow characteristics, runoff-storage relationships, frequencies of adverse high and low-flow conditions, dependable yields from storage impoundments and optimum streamflow regulation. The use and operation of Mother Brook in diverting flows from the Charles to the Neponset River will be reviewed and studied. This will require consideration of Neponset River hydrology.

(f) Inventory, screen, and analyze sites for water resource development in cooperation with other agencies to fulfill the needs for water supply, water-oriented recreation, fish and wildlife conservation, streamflow augmentation, and other purposes.

(g) Correlate and consolidate information from studies by participating Federal agencies and from states and provide leadership for the cooperative formulation of a comprehensive framework plan of development of the water resources of the Watershed. The Corps will draft the main report on the investigations and coordinate it at field level with the participating Federal and State agencies.

B. DEPARTMENT OF AGRICULTURE

(1) Soil Conservation Service (in cooperation with the Economic Research Service and Forest Service) is to:

(a) Inventory the present upstream water and related land resources.

(b) Determine present and projected agricultural, and rural needs for water.

(c) Determine the location and extent of present and projected damages from flood water, erosion, sediment and inadequate drainage, by tributary watershed, including the determination of the land use and cropping patterns on the lands benefitted by flood prevention and agricultural water management measures.

(d) Study the agricultural flood damages on the main stem and major tributaries and the impact of proposed major structures on agriculture, as requested by the Corps of Engineers or other agencies.

(e) Determine the needed land use adjustments and treatment on open land to assure optimum utilization of the land resources within the capability of the lands.

(f) Appraisal of alternative programs for meeting planning objectives.

(g) Leadership in preparing a report on the results of the Department's survey.

(h) Inventory, classify and correlate forest resources in and adjacent to the watershed in terms of present and potential use, physical characteristics, condition, and management levels.

(i) Analyze forest resources as related to current and long-range water management needs with regard to erosion control, flood prevention, water supply, and water quality.

(j) Inventory and analyze the use of natural resources by forest-based enterprises and related industries and their contribution to the present and prospective economic activity and employment in the watershed.

(k) Appraise the relationship of forest resources to water problems and needs of the watershed and appraise potential of forest land and water resources for recreational purposes.

(l) Estimate probable effects of proposed projects and programs on forest resource yields.

(m) Appraise alternative programs for meeting planning objectives and participation in the preparations of the Departmental report.

C. DEPARTMENT OF COMMERCE

(1) Economic Development Administration. Provide consulting service as to needs in the region and impacts of proposed improvements on redevelopment areas.

(2) Bureau of the Census. Furnish population and economic data as available on request.

(3) Bureau of Public Roads. Provide consultation as to current and future plans for road improvements or modification in the region and effect of proposed projects on existing and planned highways.

(4) Weather Bureau. Furnish meterological data and available studies as requested along with their views as to flood warning measures.

D. DEPARTMENT OF THE INTERIOR

(1) Federal Water Pollution Control Administration is to:

(a) Prepare an inventory of existing non-rural water supplies, both municipal and industrial to include the following information:

Present municipal water use will be determined as an aid to forecasting future demands. Significant type of municipal users, distribution and treatment will be inventoried. Fluctuation in water use indicating categories of use where such fluctuation takes place. Data will be obtained on maximum and minimum present water use and daily, weekly and seasonal fluctuations.

Present industrial water uses will also be determined with information of type and size of industrial water users. Comparison will be made of Charles River Watershed Industrial water use with national users and uses in previous years.

(b) Prepare estimates of future municipal and industrial water supply demands based on changes in use from a 1960 base and tied to levels for periods identified with dates 1980 and 2020. Municipal and industrial water requirements will be presented as the difference between supported estimates of present requirements and total estimated requirements, with adjustments for relationship of developed supplies and requirements.

The support for estimates of present supply and withdrawal will include data on source of water, surface or ground, and data to support weightings used in conjunction with demographic and economic projections in estimates of future requirements. The estimates shall be made for areas within the watershed and areas outside the Charles River watershed estimated to require withdrawals from within it, also estimates of Charles River watershed withdrawals from other watersheds.

The estimated per capita future water demands which, together with estimates of future population (furnished by others), will be used to estimate total future water demands. Per capita usage by categories will be obtained as an aid in the intervals of future per capita demands. In addition, future demands due to changes in the type of demand will be estimated.

(c) Prepare estimates of changes in water quality of streams, identify those reaches of stream which will benefit from regulation and/or augmentation of flows, and estimate the magnitude of regulation and/or augmentation to effect the estimated changes in water quality. Low flow hydrology studies to be made by the Corps of Engineers will be coordinated with the Department of the Interior.

(d) Prepare estimates of benefits to be realized from:

1. Pollution abatement facilities, including treatment plants, pumping stations, sewer systems, and regulation and/or augmentation of streamflows. The Corps of Engineers will assist in this activity by providing estimates of cost of alternative storage measures as requested by the Department of the Interior.

2. Provision of storage for municipal and industrial water supplies.

(e) Participate in selection of alternative components of basin plans which include elements for water supply or flow regulation storage.

(f) Prepare report covering participation in the above items.

(2) Bureau of Outdoor Recreation is to:

(a) Furnish estimates of existing and future needs for water-related, non-municipal, outdoor recreation.

(b) Evaluate the recreation potential of specific water control structures, both existing and proposed to determine their importance in any future recreation plan.

(c) Evaluate and prepare recommendations for preservation and utilization of scenic, natural, and other water-related recreation resources consistent with other land and water uses.

(d) Prepare estimates of cost and evaluations of benefits for recreation development at project sites.

(3) National Park Service is to:

(a) Determine effect, if any, of projects proposed under the watershed study on archeological, historical, natural, and scientific resources in the watershed.

(b) Evaluate historical and archeological resources in the watershed to determine sites of national significance and those qualified for registry as National Historic Landmarks, if any.

(c) Evaluate natural and scientific resources in the watershed and identify sites of national significance and national geologic, ecologic, and scenic landmarks, if any.

(d) Participate in joint field reconnaissance of important reservoir sites which may be significant enough to warrant National Recreation Area status.

(4) Fish and Wildlife Service is to:

(a) Inventory existing resources and future needs for water-related fishing and hunting.

(b) Evaluate the fishing and hunting potential of designated water control sites, both existing and proposed, assuming management for resource conservation.

(c) Prepare analysis of effects of proposed water development projects on the fish and wildlife resource and recommend conservation and mitigation devices.

(d) Prepare summarization of relationship of fish and wildlife resource to comprehensive water resource development plan, and prepare evaluation of benefits and costs associated with the fish and wildlife proposals.

(5) Geological Survey is to:

(a) Describe general geo-hydrology of the watershed including areas of potential ground water availability within the basin and those most favorable for development.

(b) Provide advice as to the effect of plans of development on groundwater reservoirs.

9. STUDY POLICIES

a. Maximum utilization will be made of existing data such as the report of the New England-New York Inter-Agency Committee(NENYIAC) and reports of Federal, state and private agencies. Development of new data will be minimized. Examination of alternative measures will be accomplished to the maximum extent practicable by use of past studies and available records, and by reconnaissance and consultation among personnel of participating agencies.

b. The investigation will (1) identify the general nature and scope of water resource development needs which will be encountered in future years, confining planning studies to the minimum detail and scope necessary to identify these needs and (2) identify and recommend development of specific projects in which there could be Federal participation under existing legislation, and projects for state and local action.

c. The formulation of plans and evaluation of improvements will conform to policies, standards, and procedures set forth in Senate Document No. 97, 87th Congress, 2d Session, entitled: "Policies, Standards, and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources" and amendments approved jointly by the Secretaries of Agriculture, Army, Interior, and Health, Education and Welfare.

d. The report will recommend authorization for Federal construction of, or participation in, projects required to meet water resource needs by 1980.

e. The report will present an allocation, on a functional basis, of the costs of recommended projects together with appropriate recommendations for Federal and non-Federal cost sharing.

f. The report will suggest ways and means to implement the comprehensive plan recommended for initial development and to phase the construction of the elements of the plan.

g. Projects in which there are primary or substantial Federal interests and which are urgently needed may be covered by interim reports. The essentials of such interim reports will be part of the final report. It is proposed to submit an interim report early in the survey covering the critical flood problems of the Charles River Basin in Boston, Brookline and Cambridge.

h. To the extent necessary for plan implementation, the report will present basic principles which should be covered in water resource laws.

i. Public hearings will be held as required to receive information on water resource needs, problems and suggested improvements.

j. Progress reports are being prepared by the New England Division, Corps of Engineers, in accordance with existing regulations. In addition, periodic reports of status will be made to the Coordinating Committee and interested public and private groups to apprise them of the status of the investigations.

10. ELEMENTS OF INVESTIGATION

In simplest terms, there are four elements to investigations leading to a plan of water and related land resource development for a river basin. These elements are (a) the supply of resources, (b) the dam and for them, (c) the net demand or needs, and (d) a reconciliation of supply and net demand or needs. In practice, these elements are not investigated one after the other, but rather are investigated simultaneously to the extent possible. The overlapping time relation is displayed on the Sequence Diagram as procedural steps identified as Phases A through E.

(a) Supply of Resources

Because the end purpose of the comprehensive study is to provide a plan for effective water resource development and conservation, there are three aspects of resource supply which must be evaluated. First are the resources themselves, in this case surface and ground water and closely related land resources. Second are the existing developments and programs. Lastly are the potentials for further development or beneficial program implementation. The resources and resources developments and capabilities are being inventoried by various participants. Tentative identification of potentials for water storage and other resources development is being carried on at the same time.

(b) Demand for Resources

The demands for resources are not limited to the classical demand of the economist but rather combine this with wants and desires which may be met as objectives of society. Gross demand is measured in such terms as people times per capita requirement such as gallons per day of water per capita (weighting factors) or tons of product times gallons per ton of product required. Projections of gross demand are made using numbers from "Projective Economic Studies of New England" and weighting factors appropriate to anticipated future conditions as developed by separate analysis. The projective studies made in 1964-65 under contract with the Corps of Engineers and related efforts provide a common framework for use by all participants in expressing demands.

(c) Net Demands or Needs for Development

Needs are viewed as those presently unsatisfied demands or those projected to remain unsatisfied in the future without further development or improvement. They are the net of (1) present and future demands generated inside the basin or in outside areas dependent on its resources, and (2) satisfaction by existing developments and programs. Existing resource problems such as flood loss vulnerability and water quality deterioration, and the extension and expansion of these in the future are recognized in the manner

of needs. Needs are either expressed in the same terms or where appropriate in terms of the measures required to satisfy them, as for example, acre-feet of storage or miles of channel improvement. Needs topics being considered follow:

(1) Municipal and Industrial Water Supply. Present and future municipal and industrial water quantity and quality requirements to be satisfied from surface and ground water sources are to be estimated. Industrial demands are to include those to be met by municipal systems and those to be met by other means. The quantity and quality of water being returned to streams are to be estimated as a basis for judging receiving stream quality and dilution water requirements.

(2) Agricultural Water Supply. Present and future patterns and intensities of irrigation water application are to be estimated as well as the changing requirements for rural domestic water, stock water, and other agricultural water.

(3) Environmental Improvement. Flow augmentation storage although inherent in resources considerations such as Water Quality, Recreation, Power, Navigation, would be considered separately as a project purpose. The benefits would be derived from the traditional purposes served, as well as from enhancement.

(4) Navigation. Needs for additional commercial and recreational navigation facilities or for flow augmentation to improve navigation within the basin are to be considered.

(5) Recreation. Recreation needs which could be met by water resources development will be determined and analyzed as a purpose in water resources projects considered for inclusion in the recommended plan of development.

(6) Fish and Wildlife. The fishing and water-related hunting pressures shall be determined as a part of overall outdoor-recreation need and the resource development and management measures to absorb these needs on a continuing basis identified.

(7) Water Quality. Present and future requirements, based on acceptable standards for improving and protecting water quality are to be estimated and the measures necessary to provide water quality control determined. To supplement liquid waste treatment, streamflow augmentation is to be studied as a means of increasing stream capacity to assimilate effluents from treatment plants and polluted runoff from other sources.

(8) Flood Control Requirements. Flood damage data are to be reviewed and modified as necessary to provide bases for identifying damage center and for project formulation and evaluation.

(9) Major Drainage. Future requirements for drainage of lands are to be developed with particular attention to drainage problems requiring establishment of major drainage outlets.

(d) Methods of Meeting Needs (Reconciliation)

Given the needs and general potentials for meeting them, it is then the goal of planning to select the types and scales of development of these potentials which can best meet the indicated needs. A number of alternative approaches involving single purpose, and, to a larger extent, multiple-purpose solutions are to be explored. From these analyses the more efficient features emerge. These features would be studied in detail using cost-benefit and engineering analyses as the Federal interest in them becomes evident. Basic plan features would be scaled to meet needs projected to develop by 1980. However, where warranted, project scale would be increased to provide satisfaction of needs estimated to develop after 1980.

11. INTERIM REPORT

An interim report covering the flood problem in Cambridge and Brookline, adjacent to the "Charles River Basin," will be submitted early in the watershed study. A review of available reports by local interests and preliminary studies by the Corps of Engineers will be supplemented by further field investigation and studies. Insofar as it is possible, inventory and studies will be limited to and priority given to the Charles River Basin area with a view to early submission of the interim report.

12. OUTLINE FOR REPORT AND APPENDICES

The following table of contents will be followed in preparing the report.

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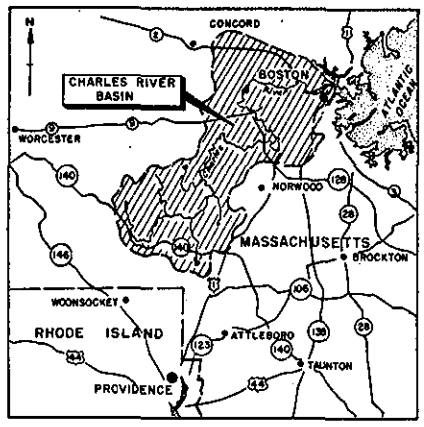
13. WORK SCHEDULE

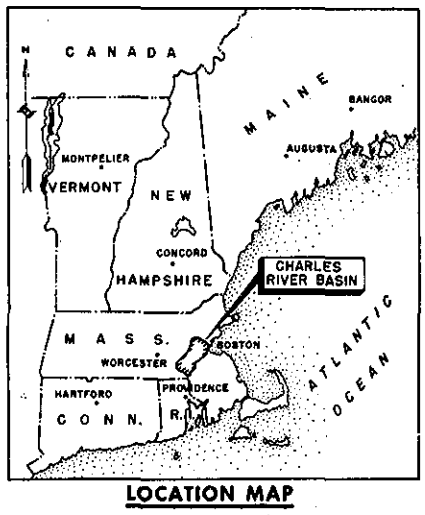
Attached sequence diagram, Exhibit 1, portrays the general sequence of work requirements for completion of the main report and appendices.



VICINITY MAP

SCALE IN MILES

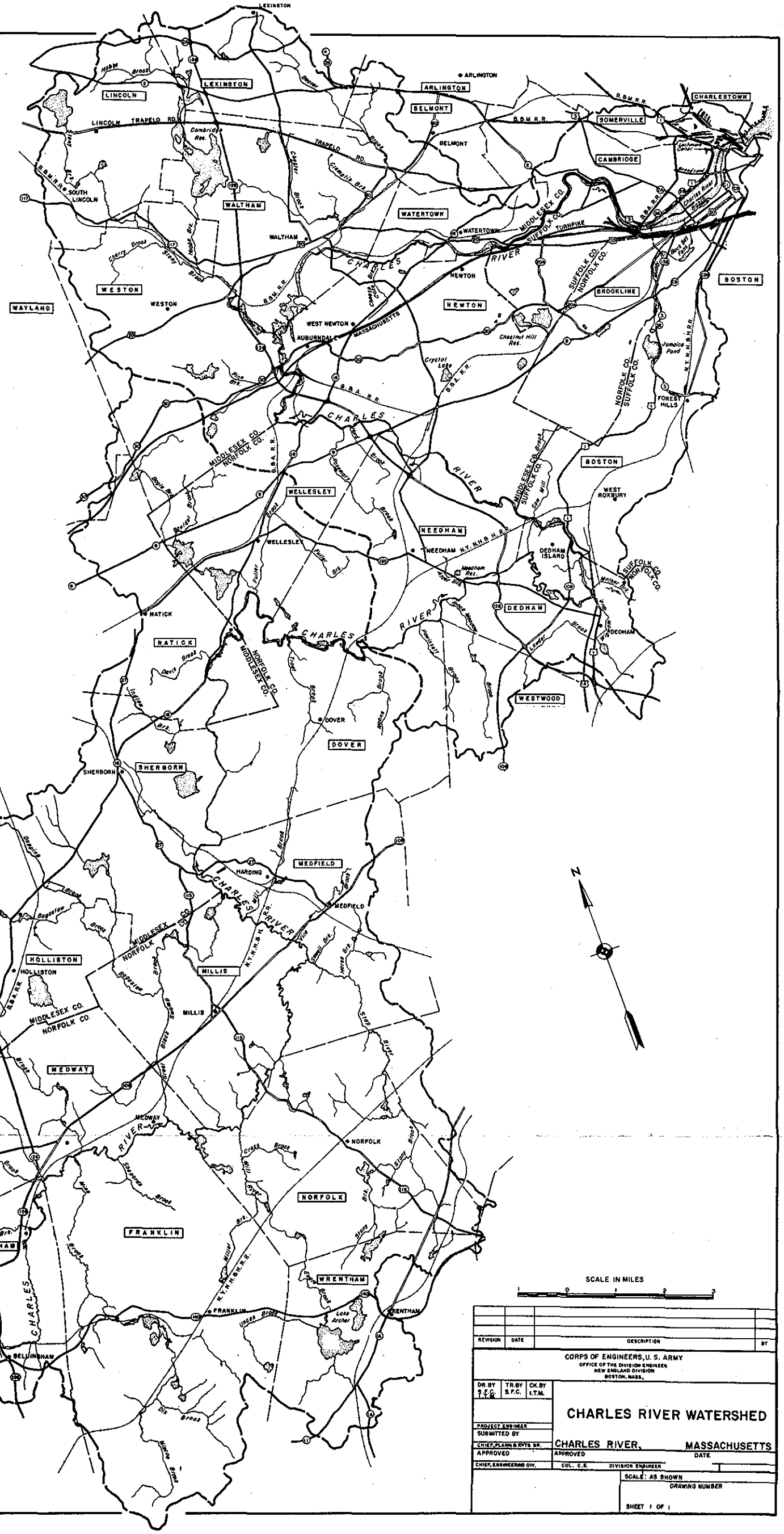
10 0 10



LOCATION MAP

SCALE IN MILES

25 0 25 50 75 100



SCALE IN MILES

0 1 2 3

REVISION	DATE	DESCRIPTION	BY

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION
BOSTON, MASS.

DR. BY	TR. BY	CK. BY
J.F.C.	S.F.C.	I.T.M.

PROJECT ENGINEER
SUBMITTED BY
CHIEF, PLANS & RPTS BR.
APPROVED
CHIEF, ENGINEERING DIV.

CHARLES RIVER WATERSHED

CHARLES RIVER, MASSACHUSETTS

APPROVED DATE

COL., C.E. DIVISION ENGINEER

SCALE: AS SHOWN

DRAWING NUMBER

SHEET 1 OF 1